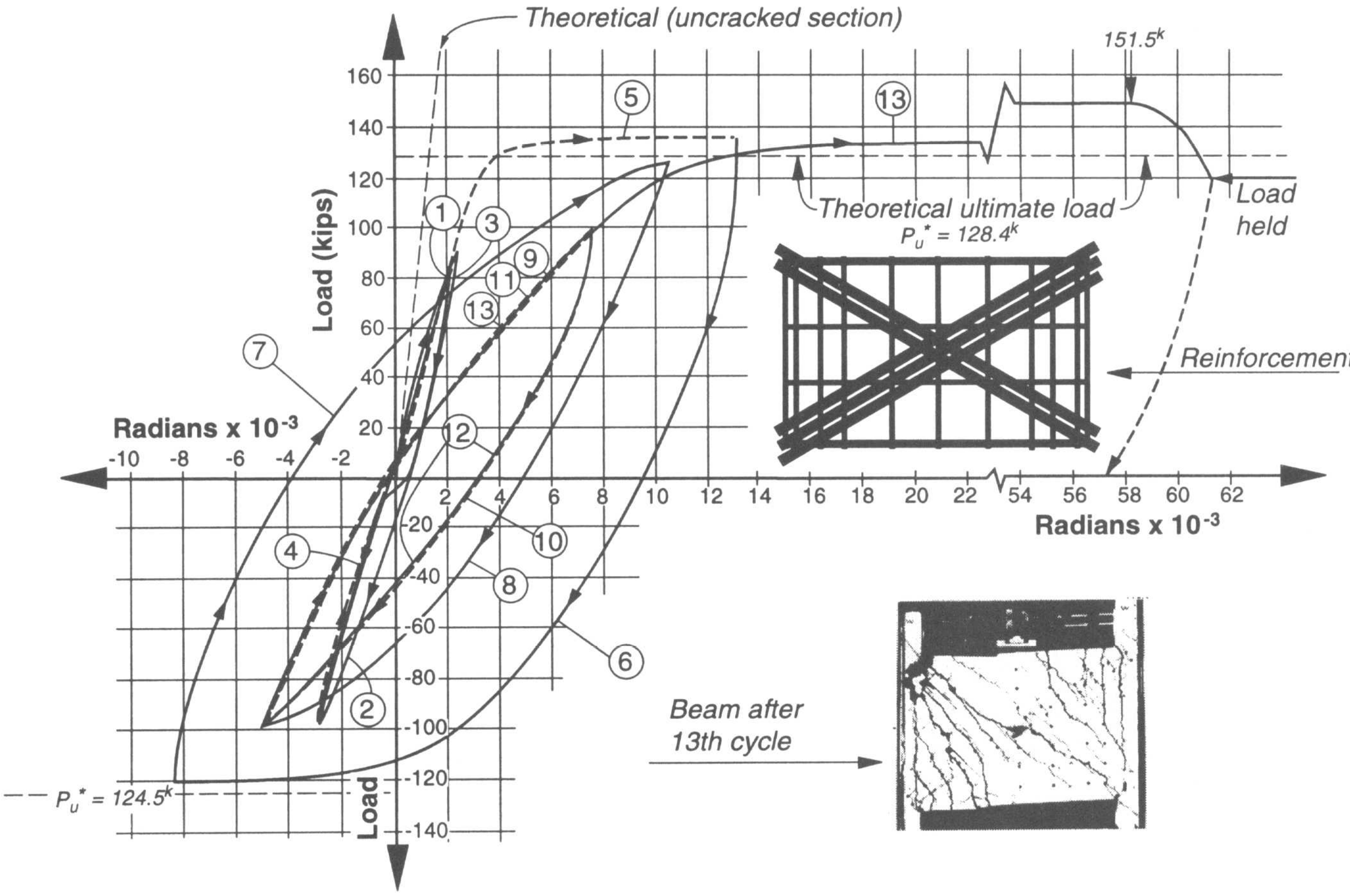
DAMAGE PATTERNS AND HYSTERETIC RESPONSE

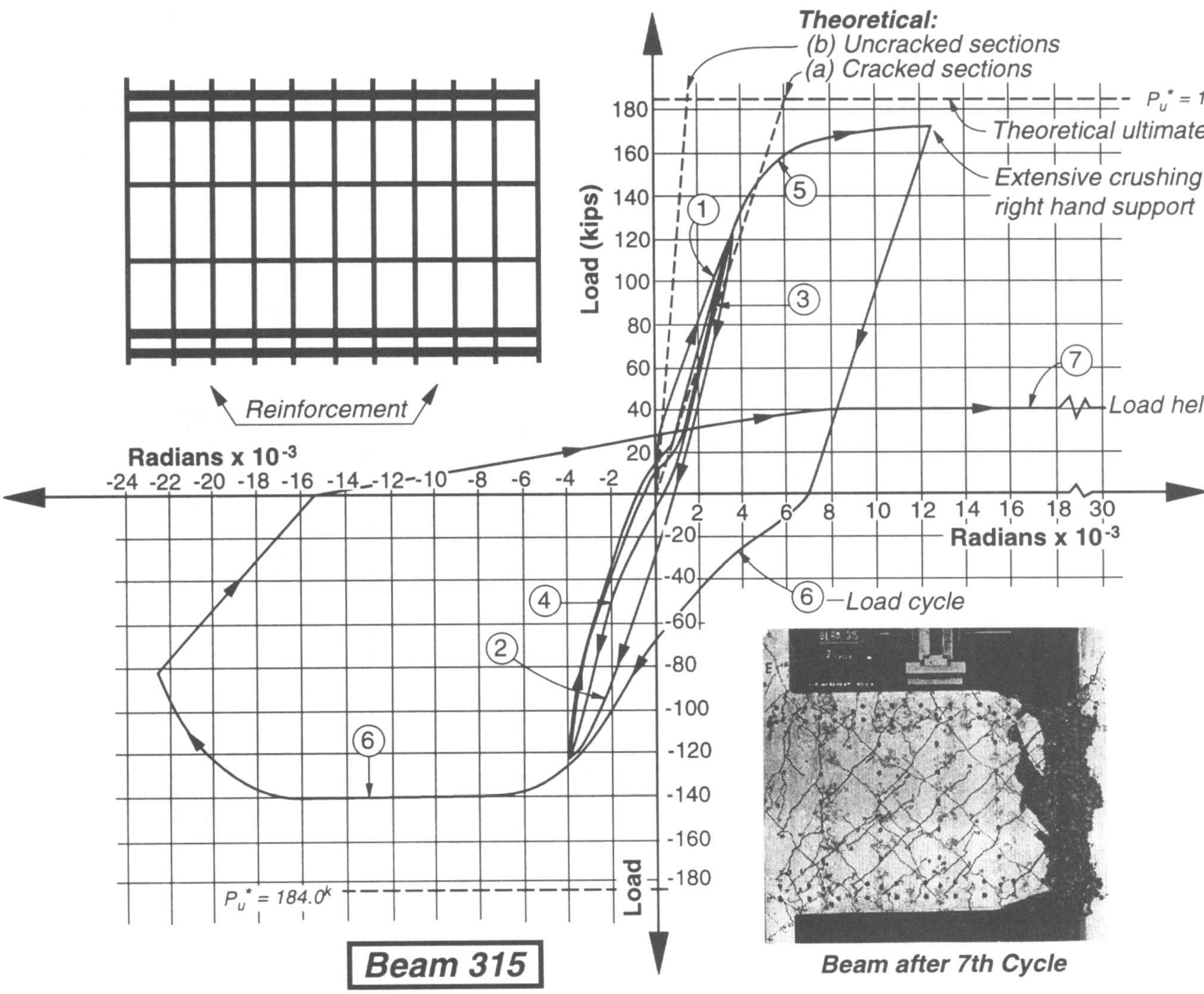
System:	**Reinforced Concrete**	RC3A	**Example 1 of 1**
Component Type:	**Weaker Spandrel or Coupling Beam**		
Predominant Behavior Mode:	**Ductile Flexure**		
Secondary Behavior Mode:	—		
Reference:	Paulay & Binney (1974)		
Specimen:	Beam 316		



Load-rotation relationship for Beam 316.

DAMAGE PATTERNS AND HYSTERETIC RESPONSE

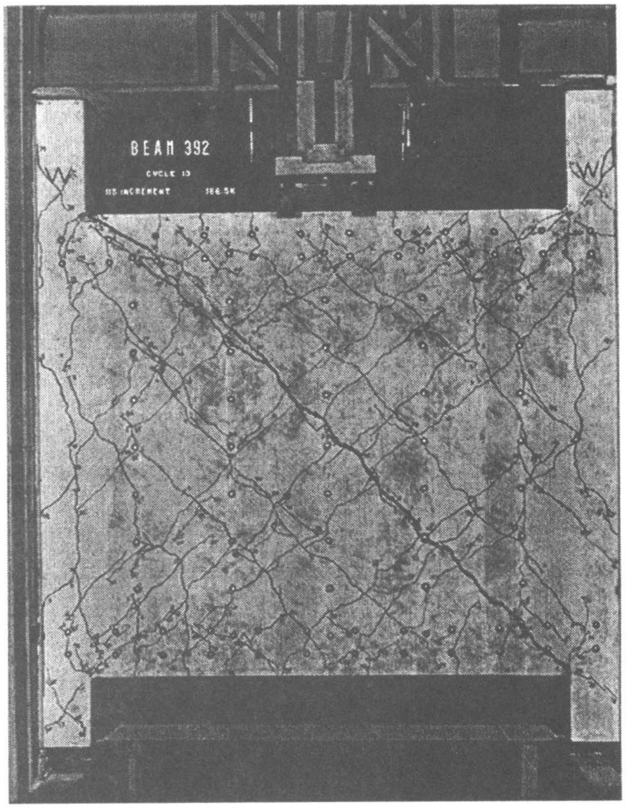
System:	**Reinforced Concrete**	RC3D **Example 1 of 1**
Component Type:	**Weaker Spandrel or Coupling Beam**	
Predominant Behavior Mode:	**Flexure/Sliding Shear**	
Secondary Behavior Mode:	—	
Reference:	Paulay & Binney (1974)	
Specimen:	Beam 315	



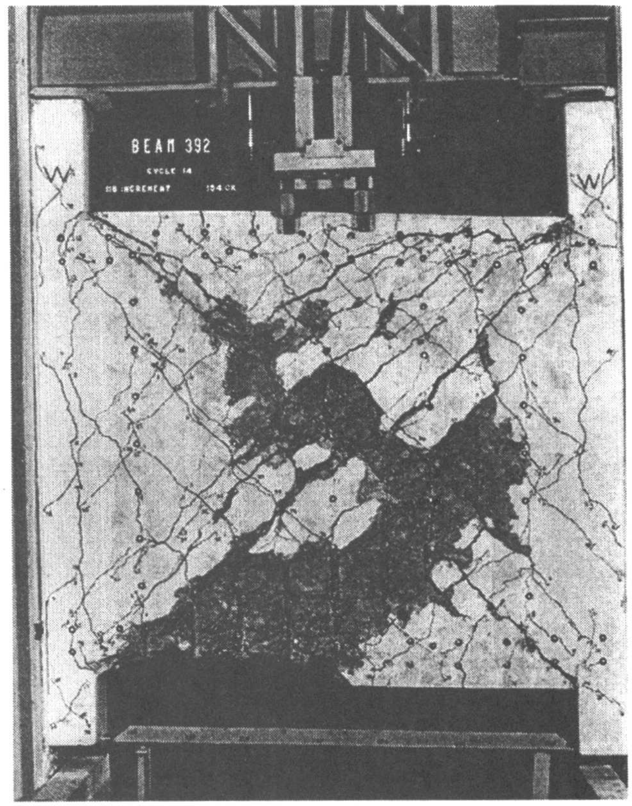
Load-rotation relationship for a conventional coupling beam.

DAMAGE PATTERNS AND HYSTERETIC RESPONSE

System:	**Reinforced Concrete**	**RC3H** Example 1 of 1
Component Type:	**Weaker Spandrel or Coupling Beam**	
Predominant Behavior Mode:	**Preemptive Diagonal Tension**	
Secondary Behavior Mode:	—	
Reference:	Paulay (1977), Paulay (1986)	
Specimen:	Beam 392	



Beam 392 after being subjected to seismic-type loading: Cycle 13.



Beam 392, Cycle 14.

2.3 Tabular Bibliography

Table 2-2 contains a brief description of the key technical reports that address specific reinforced concrete component behavior. The component types and their behavior modes are indicated The full references can be found in Section 2.5.

Table 2-2 Key References on Reinforced Concrete Wall Behavior.

Reference	Description	Comp.	Behavior modes Addressed											
		Types	A	B	C	D	E	F	G	H	I	J	K	L
EVALUATION AND DESIGN RECOMMENDATIONS:														
ACI 318 (1995)	Code provisions for the design of r/c walls. Distinct behavior modes are often not considered explicitly.	RC1 – RC4												
Paulay & Priestley (1992)	Comprehensive recommendations for the design of r/c walls. Considers all component types and prevalent behavior modes.	RC1 – RC4	•	•	•	•	•		•	•			•	
Oesterle et al (1983)	Development of a design equation for web crushing strength. Strength is related to story drift and correlation with research results is shown.	RC1			•									
OVERVIEWS OF TEST RESULTS:														
Wood (1991)	Review of 27 specimens. 24 cyclic-static loading, 3 monotonic loading. "Slender" walls: $1.1 < M/VL < 2.9$, All specimens reached flexural yield. Failure categorized as either "shear" or "flexure".	RC1												
Wood (1990)	Review of 143 specimens. 50 cyclic-static loading, 89 monotonic loading, 4 repeated unidirectional loading. "Short" walls: $0.23 < M/VL < 1.7$. Review focuses on maximum strength. Failure modes and displacement capacity not addressed	RC1												
ATC-11(1983)	Commentary on implications of r/c wall test results and design issues.	RC1, RC3												
Sozen & Moehle (1993)	Review of wall test results applicable to nuclear power plant structures. Focused on predicting initial stiffness.	RC1												

[1] Behavior modes:

A Ductile Flexural Response
B Flexure/Diagonal Tension
C Flexure/Diagonal Compression (Web Crushing)
D Flexure/Sliding Shear
E Flexure/Boundary-Zone Compression
F Flexure/Lap-Splice Slip
G Flexure/Out-of-Plane Wall Buckling
H Preemptive Diagonal Tension
I Preemptive Web Crushing
J Preemptive Sliding Shear
K Preemptive Boundary Zone Compression Failure
L Preemptive Lap-Splice Failure
M Global foundation rocking of wall
N Foundation rocking of individual piers

Table 2-1 Key References on Reinforced Concrete Wall Behavior (continued)

Reference	Description	Comp. Types	Behavior modes Addressed A	B	C	D	E	F	G	H	I	J	K	L
DETAILED TEST RESULTS:														
Barda (1972) Barda, Hanson & Corley (1976) (Lehigh Univ.)	8 test specimens: 6 cyclic-static loading, 2 monotonic loading, Small axial load. Approx. 1/3 scale, flanged walls. Low-rise: M/VL = 1.0, 0.5, 0.25. Wall vertical & horiz. reinf. and flange longit. reinf. varied 1 specimen repaired by replacement of web concrete and tested.	RC1									•	•		
Oesterle et al (1976) Oesterle et al (1979) (Portland Cement Association)	16 test specimens: 2 rectangular, 12 barbell, 2 flanged. M/VL = 2.4. Approx. 1/3 scale. Variables include boundary longit. and hoop reinf., wall horiz. reinf., axial load, load history 2 specimens repaired and tested.	RC1	•		•		•		•					
Shiu et al (1981) (Portland Cement Association)	2 test specimens. One solid wall and one wall with openings. Approx. 1/3 scale. Rectangular sections. Solid wall governed by sliding shear. Wall with openings was governed by diagonal compression in the piers. Coupling beams were not significantly damaged.	RC1, RC2, RC4			•	•								
Wang, Bertero & Popov (1975) Vallenas, Bertero & Popov (1979) (U.C. Berkeley)	10 test specimens: 6 barbell and 4 rectangular. 5 cyclic-static loading, 5 monotonic. 1/3 scale, modeled bottom 3 stories of 10-story barbell wall and 7-story rectangular wall. 5 specimens repaired with replacement of damaged rebar and crushed concrete.	RC1			•		•	•	•					
Iliya & Bertero (1980) (U.C. Berkeley)	2 test specimens. Barbell-shaped sections. Combination of cyclic-static and monotonic loading. 1/3 scale, modeled bottom 3 stories of 10-story barbell wall. Specimens repaired with epoxy injection of cracks after minor damage then subsequently repaired (after major damage) with replacement of damaged rebar and crushed concrete.	RC1			•			•						

[1] Behavior modes:

A Ductile Flexural Response
B Flexure/Diagonal Tension
C Flexure/Diagonal Compression (Web Crushing)
D Flexure/Sliding Shear
E Flexure/Boundary-Zone Compression
F Flexure/Lap-Splice Slip
G Flexure/Out-of-Plane Wall Buckling
H Preemptive Diagonal Tension
I Preemptive Web Crushing
J Preemptive Sliding Shear
K Preemptive Boundary Zone Compression Failure
L Preemptive Lap-Splice Failure
M Global foundation rocking of wall
N Foundation rocking of individual piers